NVLAP LAB CODE 200960-0

LM-79-08 Test Report

for

Maxlite Inc.

12 York Ave West Caldwell NJ 07006

LED T8 Lamp (By Pass)

Model: L15T8SE435-G

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ15080012d

The laboratory that conducted the testing detailed in this report has been accredited for SSL by NVLAP.

Review by: April Zou

Engineer: April Zou

Aug. 31, 2015

Approved by: Jim Zhang

Manager: Jim Zhang

Aug. 31, 2015

Note: This report does not imply product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Test Summary

Sample Tested: **L15T8SE435-G**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
116.6	1786.0	15.32	0.9682

CCT (K)	CRI	Stabilization Time (Light & Power)
3489	85.2	60

Table 1: Executive Data Summary

Note: The above results are recorded/ derived from measurements made using an Integrating Sphere.

Test specifications:

Date of Receipt	: Aug. 06, 2015
Date of Test	: Aug. 07, 2015 to Aug. 27, 2015
Test item	: Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters
Reference Standard	: IESNA LM-79-2008 Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

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Sample Photo

Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: LED T8 Lamp (By Pass)
Model	: L15T8SE435-G
Electrical Ratings	: 120-277V, 50/60Hz, 15W
Product Description	: 3500K, Frosted lens, G13 base
Manufacturer	: Maxlite Inc.
Address	: 12 York Ave West Caldwell NJ 07006

TEST RESULTS

Test ambient temperature was 25.0℃.

Base orientation was Light down. Test was conducted without a dimmer in the circuit.

The stabilization time of the sample was 60 minutes, and the total operating time including stabilization was 65 minutes.

Sphere-Spectroradiometer Method

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.132	0.062
Power Factor	0.9682	0.9045
Test Power (W)	15.32	15.52
THD A%	22.81	17.01
Luminous Efficacy (lm/W)	116.6	
Total Luminous Flux (lm)	1786.0	
Color Rendering Index (CRI)	85.2	
R9	18.7	
Correlated Color Temperature (CCT) (K)	3489	
Chromaticity Chroma x	0.4052	
Chromaticity Chroma y	0.3893	
Chromaticity Chroma u	0.2362	
Chromaticity Chroma v	0.3404	
Duv	0.0008	
Chromaticity Chroma u ’	0.2362	
Chromaticity Chroma v’	0.5106	

Special Color Rendering Indices	
R1	85.1
R2	95.5
R3	93.4
R4	81.7
R5	85.3
R6	93.4
R7	83.2
R8	64.1
R9	18.7
R10	89
R11	81.4
R12	73.7
R13	88.2
R14	97

Table 2: Test data per Sphere-Spectroradiometer Method

Note: According to CIE 1976 (u’,v’) diagram, u’ = u = 4x/(-2x+12y+3), v’ = 3v/2 = 9y/(-2x+12y+3).

Goniophotometer Method

Test ambient temperature was 25.1℃.

The photometric distance is 30m.

Luminous data was taken at 0.5°vertical intervals and 10°horizontal intervals.

Parameter	Result
Test Voltage (V)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.132
Power Factor	0.9672
Test Power (W)	15.35
Luminous Efficacy (lm/W)	114.3
Total Luminous Flux (lm)	1754.6
Beam Angle (°)	114.1 (0°-180°)/ 216.4 (90°-270°)
Center Beam Candle Power (cd)	294
Maximum Beam Candle Power (cd)	294.4 (At: C=230.0, Gamma=1.5)
Spacing Criteria	1.28 (0°-180°)/ 1.44 (90°-270°)
Zonal Lumens in the 0°-60°Zone	43.51%
Zonal Lumens in the 60°-90°Zone	27.05%
Zonal Lumens in the 90°-120°Zone	17.24%
Zonal Lumens in the 120°-180°Zone	12.20%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

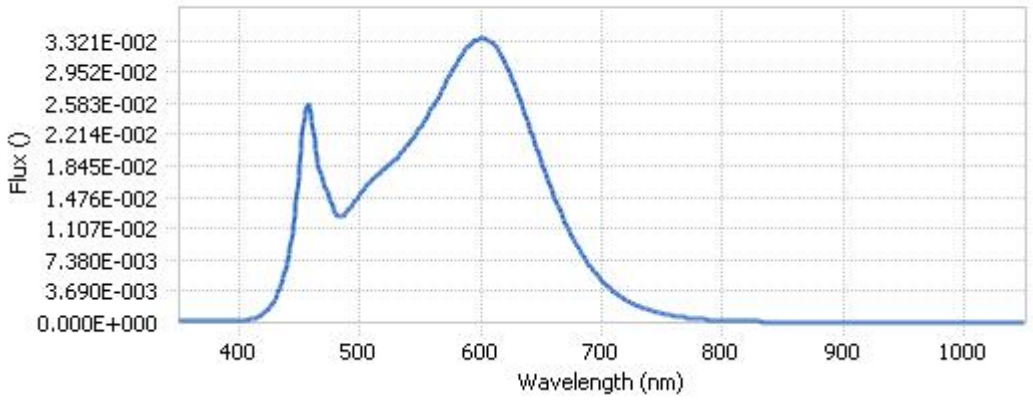
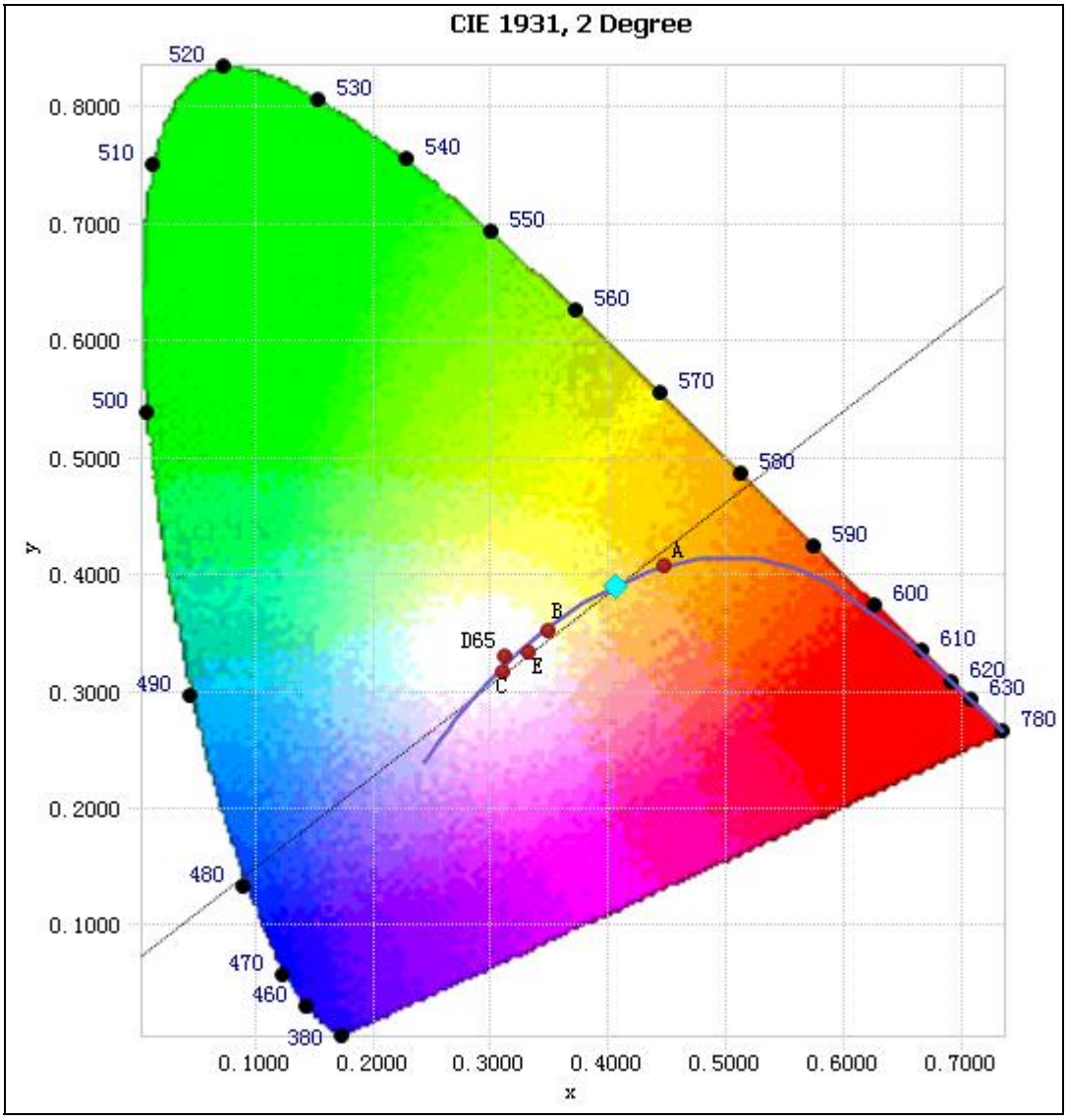


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.56E-04	485	1.26E-02	590	3.26E-02	695	5.78E-03
385	2.10E-04	490	1.33E-02	595	3.33E-02	700	4.97E-03
390	2.28E-04	495	1.41E-02	600	3.35E-02	705	4.27E-03
395	2.41E-04	500	1.51E-02	605	3.32E-02	710	3.65E-03
400	2.76E-04	505	1.61E-02	610	3.28E-02	715	3.12E-03
405	2.85E-04	510	1.68E-02	615	3.19E-02	720	2.69E-03
410	4.15E-04	515	1.75E-02	620	3.05E-02	725	2.30E-03
415	6.36E-04	520	1.80E-02	625	2.90E-02	730	1.97E-03
420	1.06E-03	525	1.87E-02	630	2.72E-02	735	1.69E-03
425	1.77E-03	530	1.94E-02	635	2.53E-02	740	1.43E-03
430	2.94E-03	535	2.02E-02	640	2.32E-02	745	1.22E-03
435	4.72E-03	540	2.12E-02	645	2.11E-02	750	1.05E-03
440	7.38E-03	545	2.20E-02	650	1.90E-02	755	9.00E-04
445	1.16E-02	550	2.30E-02	655	1.70E-02	760	7.77E-04
450	1.86E-02	555	2.43E-02	660	1.51E-02	765	6.67E-04
455	2.50E-02	560	2.54E-02	665	1.34E-02	770	5.71E-04
460	2.36E-02	565	2.67E-02	670	1.17E-02	775	4.94E-04
465	1.87E-02	570	2.80E-02	675	1.02E-02	780	4.26E-04
470	1.63E-02	575	2.94E-02	680	8.93E-03		
475	1.45E-02	580	3.05E-02	685	7.74E-03		
480	1.28E-02	585	3.17E-02	690	6.70E-03		

Table 4: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4052, 0.3893)

Chart 2: Chromaticity Diagram per Sphere - Spectroradiometer Method

Note: The location on the diagram of the tristimulus coordinates are indicated by the blue diamond.

Nominal CCT Quadrangles – Sphere Spectroradiometer Method

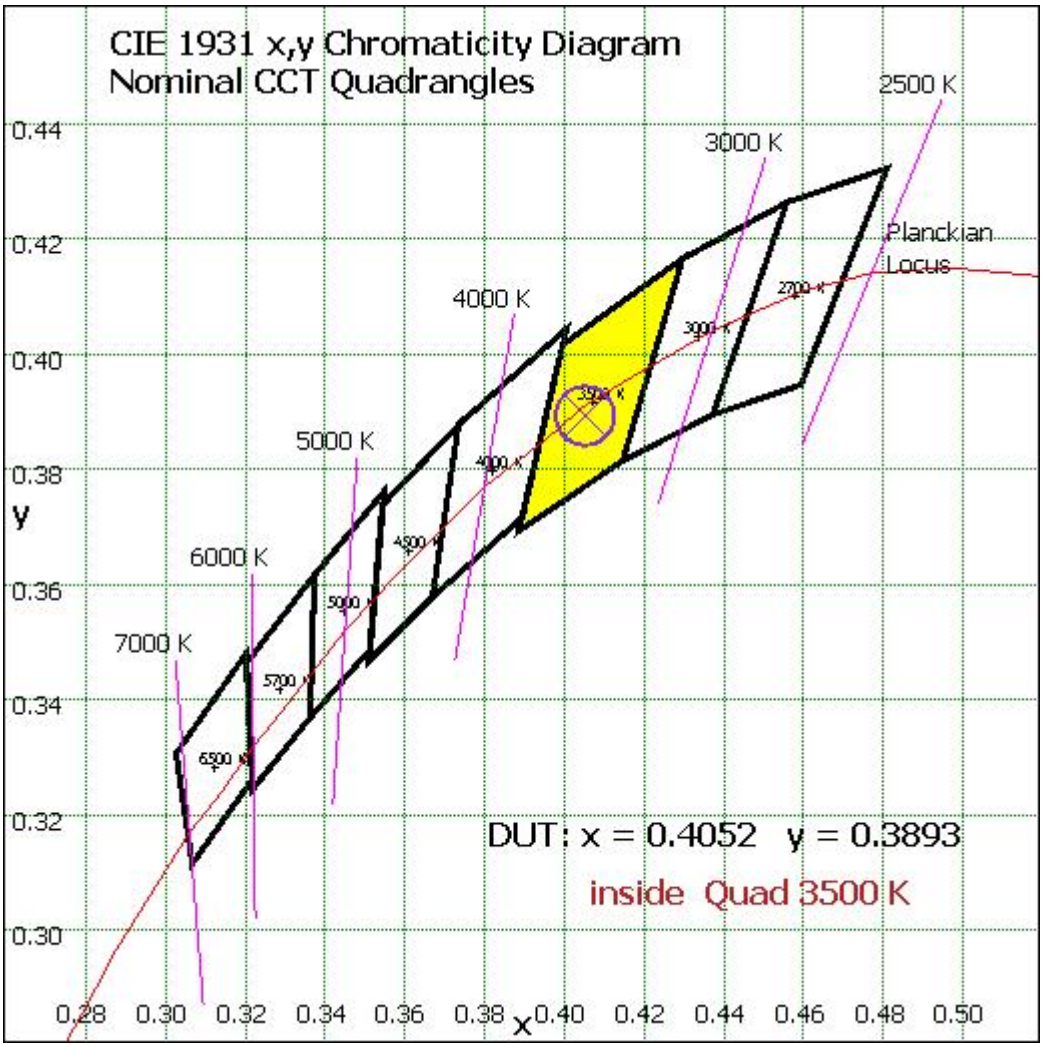


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	27.943	1.59%
10- 20	81.193	4.63%
20- 30	126.83	7.23%
30- 40	160.85	9.17%
40- 50	180.739	10.30%
50- 60	185.869	10.59%
60- 70	177.621	10.12%
70- 80	159.474	9.09%
80- 90	137.528	7.84%
90-100	118.031	6.73%
100-110	100.468	5.73%
110-120	83.985	4.79%
120-130	68.976	3.93%
130-140	55.284	3.15%
140-150	41.853	2.39%
150-160	28.069	1.60%
160-170	15.155	0.86%
170-180	4.749	0.27%
Total	1754.6	100%

γ(°)	Lumens	% Total
0- 60	763.424	43.51%
60- 90	474.623	27.05%
0-90	1238.047	70.56%
90- 180	516.57	29.44%
0- 180	1754.6	100%

Table 5: Zonal Lumen Data

Illuminance Plots- Goniophotometer Method

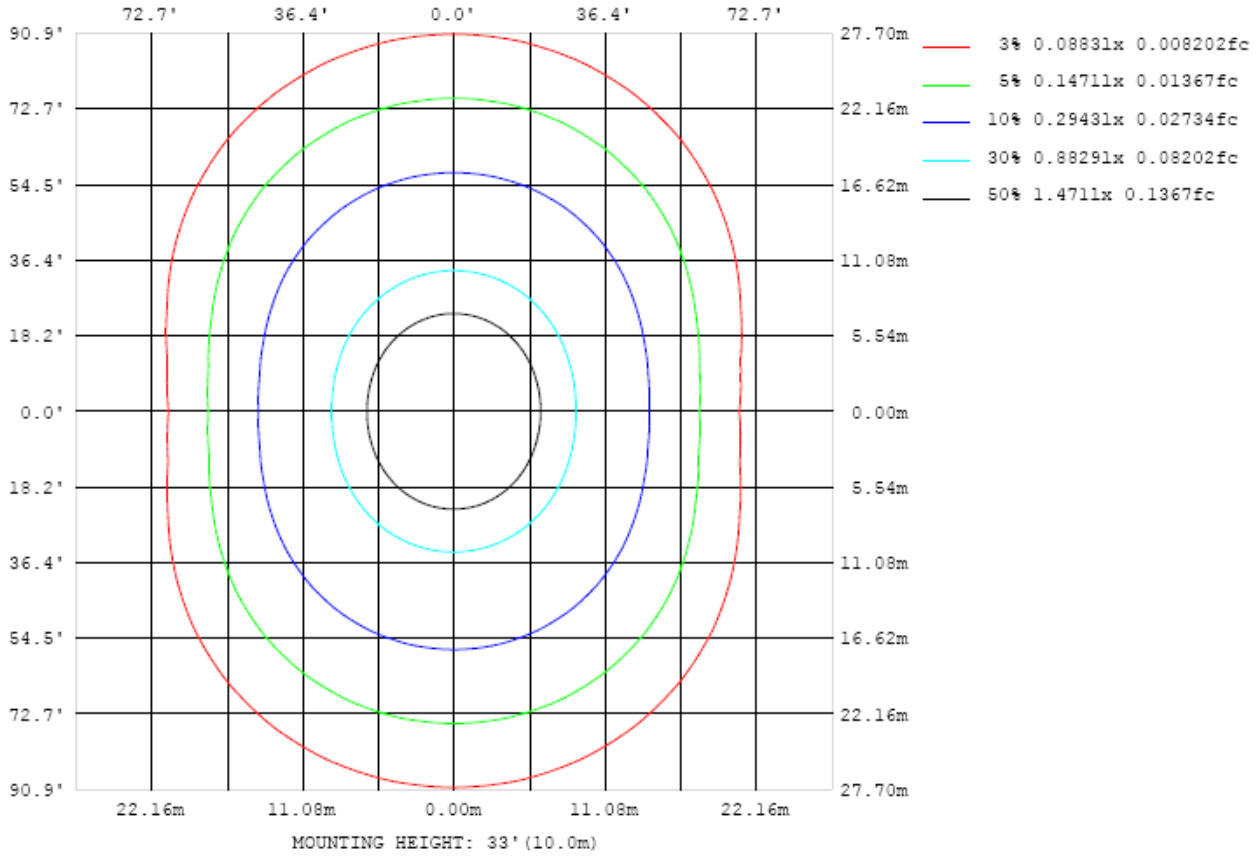


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

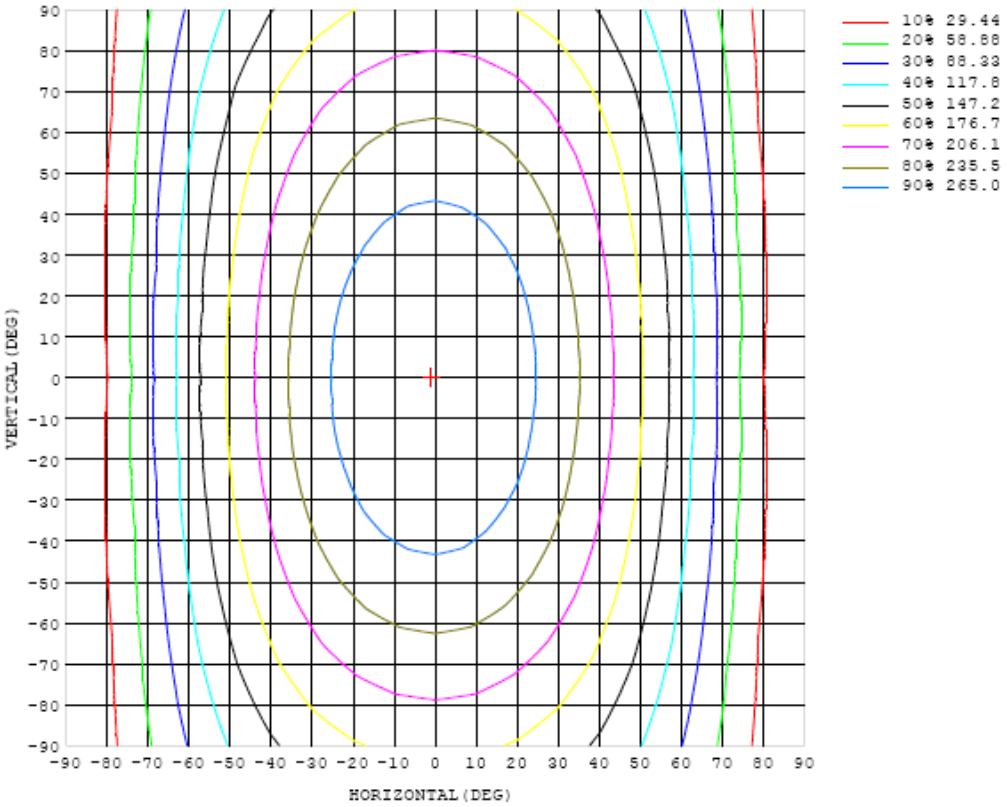


Chart 5: Isocandela Plot

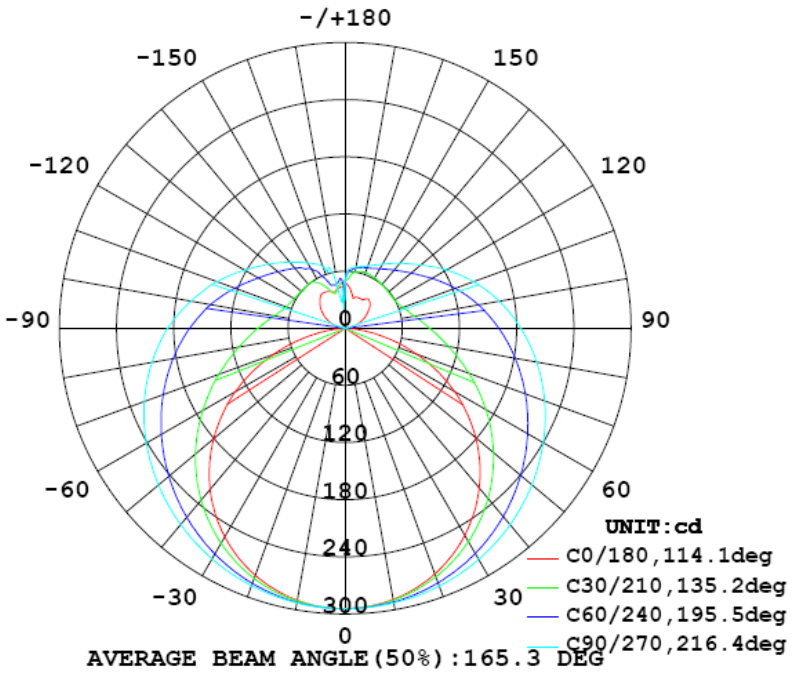


Chart 6: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

C(DEG) / γ (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294
5	293	293	293	293	293	294	294	294	294	294	294	294	294	294	293	293	294	293	293
10	289	289	290	290	290	291	292	292	293	293	293	293	292	292	292	291	290	290	290
15	283	283	284	285	286	287	289	290	291	291	291	291	290	288	288	286	285	284	284
20	274	275	276	278	280	282	284	286	288	288	288	287	286	284	282	280	278	277	276
25	264	264	266	269	272	276	279	282	284	284	284	283	281	278	274	271	269	266	266
30	251	252	254	258	264	269	273	277	279	280	280	278	275	270	265	261	257	254	253
35	236	237	241	246	253	260	266	271	274	275	274	272	268	262	255	249	244	239	238
40	219	220	225	233	242	250	258	264	268	269	268	265	260	252	244	236	228	223	221
45	200	202	209	219	230	240	249	257	261	263	261	258	251	242	232	221	211	204	202
50	179	182	191	203	217	230	240	249	254	256	254	250	242	231	219	205	193	184	180
55	156	160	171	187	203	218	231	240	246	248	246	241	232	220	205	189	173	161	157
60	132	137	151	170	190	207	221	231	238	240	238	232	222	209	191	172	153	138	133
65	106	113	131	154	176	196	211	222	229	231	229	223	212	197	178	155	132	114	107
70	80.1	89.0	111	138	163	184	201	213	220	223	220	214	202	186	164	139	112	89.3	80.3
75	54.3	66.0	92.9	123	151	174	191	204	211	213	211	204	192	175	152	125	93.8	65.6	53.7
80	29.7	45.3	76.7	110	139	163	181	194	201	204	201	194	182	164	140	111	77.6	45.3	28.8
85	9.75	28.9	63.5	98.4	128	153	171	184	192	194	192	184	172	153	129	99.6	65.9	29.3	9.03
90	0.30	19.5	54.6	88.7	119	143	161	174	182	184	182	174	162	144	120	90.0	56.0	20.6	0.44
95	1.67	16.1	48.3	80.8	110	133	152	164	172	174	172	164	152	134	111	82.1	49.8	17.5	1.94
100	5.00	16.4	43.9	74.0	102	124	142	154	162	164	162	155	142	125	103	75.3	45.5	17.9	5.55
105	9.41	19.3	41.5	69.3	94.0	116	132	144	152	154	151	144	133	116	94.9	70.1	43.2	20.8	10.3
110	14.1	23.1	41.2	64.4	87.1	107	123	134	141	143	141	134	123	108	88.0	65.8	43.0	24.7	15.3
115	19.2	27.7	42.2	61.4	81.0	99.1	114	124	131	133	131	125	114	99.8	81.9	63.0	44.0	29.3	20.4
120	24.1	32.6	44.1	59.7	76.1	91.8	105	115	121	123	121	115	106	92.6	77.2	61.3	45.9	34.2	25.3
125	28.7	37.0	46.4	59.0	72.5	85.8	97.0	106	111	113	111	106	97.6	86.7	73.8	60.5	48.1	38.6	29.7
130	33.3	41.3	48.9	59.2	70.3	80.9	90.4	97.6	102	104	102	97.9	91.1	81.9	70.9	60.2	50.4	42.8	34.1
135	36.8	44.9	51.6	59.5	68.4	76.9	84.7	90.8	94.5	95.8	94.7	91.2	85.5	77.8	69.5	60.7	52.7	46.4	37.9
140	38.9	47.7	54.1	60.1	66.9	73.5	79.9	84.9	87.9	89.0	88.1	85.2	80.6	74.4	67.9	61.2	54.3	49.1	41.2
145	37.9	49.6	56.4	60.8	65.7	70.8	75.8	79.7	82.2	83.0	82.3	80.1	76.4	71.6	66.6	61.3	55.9	52.1	43.8
150	35.0	51.5	58.4	61.4	65.3	68.9	72.3	75.3	77.1	77.8	77.3	75.6	72.9	69.5	65.6	60.1	55.1	51.3	43.7
155	35.0	54.6	59.6	62.1	64.8	67.1	69.4	71.5	72.9	73.4	73.1	71.9	69.9	67.9	64.8	59.2	54.3	49.0	42.7
160	35.0	52.5	60.8	62.4	64.3	66.2	67.5	68.5	69.5	69.8	69.5	68.7	68.0	66.0	60.4	53.3	49.1	45.6	40.8
165	32.5	48.9	59.6	61.8	63.2	65.0	66.1	66.8	67.3	67.6	67.4	67.2	65.5	60.1	53.5	49.2	46.2	44.6	40.4
170	38.0	46.9	56.4	60.0	61.3	62.9	64.6	65.1	65.3	65.4	65.6	64.1	59.5	52.5	47.5	45.0	45.2	44.3	42.7
175	44.2	47.1	50.8	54.7	57.3	59.1	61.3	63.1	63.7	63.4	62.5	59.3	52.3	45.1	41.0	40.0	41.0	42.7	43.6
180	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4

Table 6: Luminous Intensity Data

Table--2 UNIT: cd

C(DEG) / γ (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294		
5	293	293	293	294	294	294	294	294	294	294	294	294	293	293	293	293	293		
10	290	291	291	291	292	292	293	293	293	292	292	292	291	291	290	289	289		
15	284	285	286	287	288	289	290	290	290	290	289	289	287	286	285	284	283		
20	277	278	280	281	283	285	286	287	288	287	286	284	282	280	278	276	275		
25	266	268	271	274	277	280	282	284	284	283	281	279	276	272	269	266	264		
30	254	257	261	265	270	274	277	279	280	278	276	273	269	264	258	255	252		
35	239	243	249	255	261	267	271	274	275	273	270	266	260	253	247	241	237		
40	223	228	235	244	252	259	264	268	269	267	264	258	251	242	233	226	221		
45	204	211	221	232	242	251	257	261	263	261	257	250	241	230	219	209	202		
50	184	193	205	219	231	242	250	254	256	254	249	241	230	217	204	191	182		
55	162	173	189	206	220	232	241	247	249	247	241	232	220	204	188	172	161		
60	139	154	173	192	209	223	233	239	241	239	233	223	209	191	171	153	138		
65	115	134	157	179	198	213	224	231	233	231	224	213	198	178	156	133	114		
70	90.4	114	141	166	187	203	215	222	224	222	215	203	187	165	140	113	90.1		
75	66.8	95.5	127	154	176	193	206	213	215	213	206	193	176	153	125	94.5	66.4		
80	45.8	79.3	113	143	166	183	196	204	206	204	196	183	165	142	112	78.1	45.1		
85	29.9	66.3	102	132	155	173	186	194	196	194	186	173	155	131	100	64.8	28.6		
90	21.0	56.8	91.9	122	146	163	176	184	186	184	176	163	146	121	90.4	55.1	19.4		
95	17.5	49.8	83.2	112	136	153	166	173	176	173	166	153	135	111	81.6	47.8	15.8		
100	18.2	45.4	75.9	104	126	144	155	162	165	162	155	143	125	102	74.1	43.2	16.5		
105	20.8	43.5	70.1	95.5	117	133	145	152	154	152	145	133	116	94.0	68.2	41.3	19.2		
110	24.4	43.5	66.0	88.4	108	123	135	141	143	141	134	123	107	86.8	64.1	41.3	22.4		
115	28.4	44.6	63.6	82.8	100	114	124	131	133	130	124	113	98.9	81.2	61.6	42.4	26.4		
120	32.3	46.5	62.1	78.7	93.6	106	115	120	122	120	114	105	92.4	77.0	60.2	44.2	30.4		
125	35.6	48.0	61.2	75.3	88.2	98.8	107	111	113	111	106	98.0	86.9	73.7	59.5	46.2	34.0		
130	38.4	50.3	60.0	71.6	83.7	92.6	99.4	104	105	103	98.8	91.8	82.3	71.1	59.3	48.5	37.0		
135	40.1	52.5	60.0	69.9	79.6	87.1	92.8	96.3	97.5	96.0	92.3	86.3	78.3	69.1	59.6	50.6	39.2		
140	40.3	54.0	60.7	65.9	74.5	82.3	86.9	89.8	90.8	89.6	86.4	81.5	75.0	67.4	60.0	51.9	39.6		
145	39.7	53.4	60.0	64.9	71.5	76.9	81.8	84.0	84.8	83.8	81.3	77.3	72.1	66.2	60.6	49.6	38.0		
150	38.2	47.5	54.9	60.8	64.9	72.6	76.3	78.9	79.4	78.7	76.8	73.8	69.8	65.3	61.0	45.2	35.6		
155	37.4	41.4	47.8	51.9	58.3	62.8	68.8	73.2	74.6	74.2	73.0	70.8	67.6	64.6	58.3	39.3	33.8		
160	37.1	37.3	40.1	46.2	48.3	51.2	57.2	63.8	68.4	70.5	69.0	66.7	64.4	61.2	48.7	34.6	31.8		
165	36.0	36.9	38.4	41.3	46.3	47.4	45.8	50.3	65.7	63.8	63.9	62.7	59.0	49.2	37.0	35.3	32.1		
170	42.4	41.8	44.5	45.8	47.0	48.8	49.2	45.3	34.6	54.4	52.3	50.6	46.1	42.6	43.3	41.8	37.2		
175	44.5	46.6	48.4	48.9	50.2	52.2	53.5	54.8	43.0	54.8	54.6	53.9	52.2	49.7	47.0	45.7	44.3		
180	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4	50.4		

Table 7: Luminous Intensity Data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Sep. 18, 2014	Sep. 17, 2015
Digital Power Meter	PF2010A	HZTE028-01	Sep. 18, 2014	Sep. 17, 2015
AC Power Supply	PCR 500L	HZTE001-08	Sep. 18, 2014	Sep. 17, 2015
DC Power Supply	WY12010	HZTE004-03	Sep. 18, 2014	Sep. 17, 2015
Temperature Meter	TES1310	HZTE017-01	Sep. 18, 2014	Sep. 17, 2015
Standard source	D908	HZTE012-01	Sep. 18, 2014	Sep. 17, 2015
Integrate Sphere system	2M	HZTE015-01	Sep. 18, 2014	Sep. 17, 2015
Digital Power Meter	WT210	HZTE008-01	Sep. 18, 2014	Sep. 17, 2015
AC Power Supply	PCR 500L	HZTE001-07	Sep. 18, 2014	Sep. 17, 2015
DC Power Supply	6154	HZTE004-04	Sep. 18, 2014	Sep. 17, 2015
Temperature and humidity recorder	JR900	HZTE018-01	Sep. 18, 2014	Sep. 17, 2015
Standard source	SCL-1400	HZTE012-02	Sep. 18, 2014	Sep. 17, 2015

Table 8: Test Equipment List

TEST METHODS

Seasoning of SSL Product

For the purpose of rating new SSL products, SSL products shall be tested with no seasoning.
Therefore, no seasoning was performed.

Sphere-Spectroradiometer Method- Photometric and Electrical Measurements

A Labsphere Model CDS 2100 Spectroradiometer and Two Meter Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit. The coating reflectance of each sphere is 98%. The measure geometry is 4π. Self-absorption correction is conducted in testing. Bandwidth of spectroradiometer is 350nm-1050nm.
Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation.
The stabilization time typically ranges from 30 min (small integrated LED lamps) to 2 or more hours for large SSL luminaires). It can be judged that stability is reached when the variation (maximum – minimum) of at least 3 readings of the light output and electrical power over a period of 30 min, taken 15 minutes apart, is less than 0.5 %.
Electrical measurements including voltage, current, and power were measured using the Yokogawa Power Analyzer.
The standard reference of the integrated sphere system is halogen incandescent lamp, the intensity distribution type is omni-directional, and is traceable to the National Institute of Standards and Technology.
The uncertainty of integrating sphere system reported in this document is expended uncertainty is 1.06% with a coverage factor k=2.

Goniophotometer Method

Photometric and Electrical Measurements

An EVERFINE Type C Model GO-R5000 Goniophotometer was used to measure the intensity at each angle of distribution for each sample. The photometric distance is 2.475m for near-field measurement or 30m for far-field measurement. Bandwidth of spectroradiometer is 380nm-780nm.
Ambient temperature was measured at the same height of the sample mounted on the Goniophotometer equipment. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation.
The stabilization time typically ranges from 30 min (small integrated LED lamps) to 2 or more hours for large SSL luminaires). It can be judged that stability is reached when the variation (maximum – minimum) of at least 3 readings of the light output and electrical power over a period of 30 min, taken 15 minutes apart, is less than 0.5 %.
Electrical measurements including voltage, current, and power were measured using the Everfine Digital Power Meter.
Some graphics were created with Photometric Plus software.
The standard reference of the Goniophotometer system is halogen incandescent lamp, the intensity distribution type is omni-directional, and is traceable to the National Institute of Metrology P.R. China.
The uncertainty of goniophotometer system reported in this document is expended uncertainty is 1.94% with a coverage factor k=2.

Color Characteristics Measurements

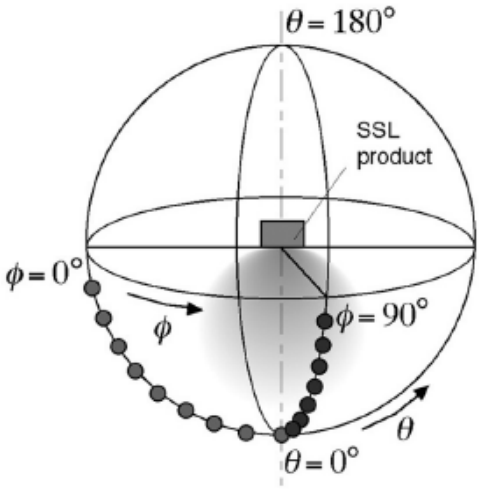
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as values that are spatially average, weighted to intensity, over the angular range where light is intentionally emitted from the SSL product. The color characteristics measurements are using gonio-spectroradiometer.

Color Spatial Uniformity

The characteristics of SSL products may be spatially non-uniform, the chromaticity coordinate shall be measured at two vertical planes (C=0°/180° and C=90°/270°) and at 10° or less intervals for vertical angle until the light output dropped to below 10% of the peak intensity. The averaged weighted chromaticity coordinate was calculated from these points. The data was then analyzed to check for delta color differences of the u', v' chromaticity coordinates. The spatial non-uniformity of chromaticity, Δu'v', is determined as the maximum deviation (distance on the CIE (u', v') diagram) among all measured points from the spatially averaged

chromaticity coordinate.

The geometry for the chromaticity measurement using gonio-spectroradiometer is shown as following.



*** End of Report ***